Impact of Manmade Interference to Terrestrial Broadcast Signals

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Introduction

I have been employed in broadcasting and cable television since April 1968. I am a licensed and active amateur radio operator with a passion for designing and building my own equipment. I have assisted in triangulation and location of interference sources, and assisted the Federal Communications Commission in locating pirate radio operators. I have been employed by Lima Communications Corporation, DBA: WLIO Television, for over thirty years, and have served as Chief Engineer and Vice President of four network affiliate digital television stations. I'm also Director of Engineering for Block Communications Inc. broadcast division. Additionally, I'm the region's EAS Co-chairman, and a past Public Information Officer for the Allen County Office of Emergency Management.

Overview of Problem

The impact of manmade noise started out as a nuisance to many radio listeners in the 1980s, but has ramped up recently with the proliferation of high-tech lighting, computer devices, and a power grid in need of routine maintenance and has become a major threat.

The power grid furnishes many instances of static and hash affecting licensed radio services. This objectionable interference is mainly contained to LW, AM, HF, and VHF services.

Early plasma televisions caused a great deal of interference, and manufacturers must have recognized the problem as early sets contained shielding. Today, shielding is gone to eliminate expense. PC boards are open designed within the plastic case lacking shielding. The impact is to the LW, AM, and HF services, but objectionable interference has been observed up to 100 megahertz at distances of 10 meters or more.

LED lights, solar chargers, and devices with high speed micro-processors and sophisticated electronics have radiated well up to 108 – 130 megahertz. Some switching power supplies offer a large amount of wideband noise even to 250 megahertz.

Clusters of LED lighting have caused objectionable interference up to 500 megahertz. Individual bulbs meet F.C.C. RFI limits, but when bulbs are clustered together for traffic signaling, marquees, signage, or grow lights, the additive noise far exceeds the limits and radiates for great distances.

When my truck's dash cam is turned on, FM radio signals are severely compromised. If the camera is placed next to my Garmin GPS the unit will fail to acquire satellites. Wideband noise from the camera even affects cellphone communications.

Real Life Interference

In the case of the dash cam, it was ordered through the Aliexpress web site and described as "Model GS8000L Car DVR Camera 2.7 inch." The camera is powered by a cigarette lighter cord connected to a USB port on the camera. When the camera is in operation, broadband noise is heard on both the AM and FM band of my in-dash radio. On the FM band the noise is of such a level that only close by Class "B" FM stations can be heard without interference. Several Class "A" FM stations as close as 19.3 kilometers are severely compromised. When my Garmin Nuvi 1450 is placed closer than 16 inches from the camera it will consistently fail to acquire satellite signals. A Motorola cellphone was placed near the camera, there was also no service.

One strange case of interference turned out to be a Kenmore dryer. It contained a circuit to sense the humidity level and regulate drum temperature and rotation. This dryer would radiate wideband interference from 150 kilohertz to 200 megahertz, impacting reception of radio signals 33 meters from the device. Using a Potomac Instruments field strength meter, 30 meters from the appliance, I was able to measure .35 mv/m. Some of the interference was being introduced back into the main power feed as I was able to measure radiating interference from the breaker panel, and even at the service termination at the pole. This interference completely wiped out the local station at 940 KHz, and made the station at 1150 KHz hard to hear.

The interference was not just limited to the AM broadcast band. The KT8APR 2-meter amateur radio repeater[1] is 914.4 meters from my home. I can see the antenna on the tower from my home. The interference from appliance was so severe that the CTCSS function on the radio failed to decode. The KT8APR DSTAR UHF[2] amateur radio repeater is located at the same tower site. An ICOM IC-91AD handheld transceiver could not decode the digital AMBE signal if within 6 meters of the appliance. AMBE is similar to P25, so it's safe to say that first responder radios would not receive under the same conditions. The manufacturer had no understanding how to correct the problem. The appliance was subsequently scrapped.

Noise had cause Public Service station KQA818 (Site 2/1424 Rice) to lose effective range. While a majority of the problem is the Motorola receiver's wide input on 151.0475 with a nearby DTV station on 183.00 MHz, noise from computers, and power line noise emanating from a primary power switch panel contributes to the loss of reception. The receiver spec is .2uV for opening squelch. But due to noise it has to be operated at nearly .85uV.

Power line noise has increased greatly in the past twenty-five years. In 1990 the noise in the HF band at my home was typically S2 to S3 level on my Yaesu HF base station radio using a Cushcraft A3S antenna. Without any change to the transmission system or radio, over the years, the noise has increased to the S7 to S9+10 level resulting in a complete loss of most useable signals. The noise also disables use of a calibration system I use to receive WWV transmissions at 5, 10, and 15 megahertz for frequency calibration.

[1] KT8APR 2-meter repeater, 145.370 megahertz (NBFM), 92 watts ERP, using a DB224 antenna @ 320 feet AAT
[2] KT8APR DSTAR repeater, 443.625 megahertz (AMBE), 232 watts ERP, using a DB420 antenna @ 336 feet AAT

The electrical noise impacts the AM and FM band as well. Stations serving the region are impossible to hear at times. There are many spots in the community where noise achieves an epic proportion. At the corner of Woodlawn Ave and Hazel Drive, (Lima OH), and for a quarter mile east of this locations NO standard AM broadcast stations can be heard. Even the local station on 1150 kilohertz with 1 kilowatt power, non-direction, from 5.3 miles away cannot be heard over the noise. This noise also creeps into the FM band on stations which are semi-local to our region.

Thirty years ago our local power utility had a regional interference expert who would solve noise problems. From start to finish it very seldom took more than five business days to track down a noise source and have a lineman replace the defective component. Today there doesn't appear to be anyone concerned about interference complaints. My complaints have fallen on deaf ears. According to an article in The Columbus Dispatch[3] the public power utility had a score of 654 out of 1,000. Quoting the paper; *"That score means AEP Ohio ranks 14th of 16 large Midwestern electricity utilities. Last year, the company was 15th out of 16."* In Lima, Ohio, a simple drive around the community tuned to the strongest station will turn up noise sources which impact local reception of radio station. Reports to the F.C.C. have gone unanswered.

During the past several National Association of Broadcasters Conventions in Las Vegas, NV, I've noticed more interference from LED lighting from signs and marquees. This broad noise will desense a mobile or handheld radio operating in VHF & UHF spectrum. This issue has been documented in several publications including; "Radio Frequency (RF) Interference from Energy Efficient Lighting"[4], and "LED lamps interfering with radio transmissions"[5].

Knowing what the interference does, and what to look for, I've noticed it more and more in cities around the United States. It comes from traffic light systems, roadside billboards, and parking light systems. The problem with LED noise has been so profound law enforcement has use the situation to their benefit to track down marijuana grow operations.[6]

We have had reports at WLIO Television, (DTV channel 8), of interference from microwave ovens, cellphone chargers, security lights, CATV egress, personal desktop and laptop computers, WiFi routers, and power substations.

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[3] Columbus Dispatch newspaper, Thursday, July 14, 2016. Business Section, page C4. "AEP Better but service ranking still low".

[4] NPSTC Final Report, June 30, 2015. "Radio Frequency (RF) Interference from Energy Efficient Lighting." http://www.npstc.org/download.jsp?tableId=37&column=217&id=3467&file=RF_Interference_from_Energy_Efficient_Lighting_Report_Final_20150630.pdf

[5] Leapfrog Lighting, News and Insights. "LED lamps interfering with radio transmissions", April 5, 2013, by Sarah Bailey. http://www.leapfroglighting.com/led-lamps-interfering-with-radio-transmissions

[6] Police One Magazine, The Drug Warrior. "How Cops are catching grow ops with AM radio." February 4, 2015, by Keith Graves. https://www.policeone.com/drug-interdiction-narcotics/articles/8224280-How-cops-are-catching-grow-ops-with-AM-radios/

Two recent emergency events proved how dangerous interference can be. On June 29, 2012, we had a huge derecho[7], and on January 5, 2005 we had a combination of freezing rain/ice storm.[8]

As the 2005 Ice Storm ramped up, many broadcasters shifted to emergency operations, warning of the potential devastation and what had happen in regions impacted by the storm. As the storm approached and the power grid started to fail many radio stations fell silent not having proper backup infrastructure. As a Public Information Officer for the Allen County Office of Emergency Management, I was dispatched to the office to handle emergency information. A normal five minute drive took thirty minutes as I had to avoid downed power lines and fallen trees. At the start of my trek the only radio station which I could hear was WIMA-1150 (Lima, OH).

As I dialed around the AM band I was struck by the noise overwhelming radio stations from outside of our community but still on the air. As I reached the downtown region, the power grid failed dumping us into darkness. But it also took away much of the noise on the AM band. I could now hear Class 1A stations WLW-Cincinnati, WTAM-Cleveland, and WJR-Detroit. Lower power stations in the region were also audible. These station became our links to news from outside our area. Once power was restored, all these stations disappeared into noise again.

This scenario was replayed on June 29, 2012, when a huge derecho tracked across Ohio. Again, local broadcasters were taken off the air, and noise remained from various sources prohibiting even reception of adjacent county radio stations unaffected by the storm until the grid failed, and noise was eliminated. Only then could we receive stations outside of our area.

WLIO Television has always taken EAS commitment seriously. Twenty years ago, in addition to our local EAS assignments, we would monitor Class 1B station WOWO-Fort Wayne, and WSPD-Toledo. These stations, (although not required to be monitored under our State of Ohio EAS plan), provided a "heads up" on emergency conditions prior to our own district coming under alert. Due to a 7.2dB increase in noise floor we have had to suspend monitoring these stations. Our EAS receivers are worthless when noise is introduced at the same level as carriers.

Some AM broadcasters have advocated increasing their transmitted ERP to "overcome" interference. This is a very poor idea. As we saw when AM Class C "Local" stations increased night power in the 1960s, the subsequent interference between each other increased having the opposite effect of improving service. Raising power to overcome noise is like turning up the stereo in your house to overcome the sound of a stereo from your neighbor's house. Once two people start a power war it's a no win situation affecting more people till nobody is void of interference. Instead of increasing power levels we should eliminate the sources of noise.

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[7] Service Assessment "The Historic Derecho of June 29, 2012", Laura K. Furgione - Acting Assistant Administrator for Weather Services, National Weather Service. http://www.nws.noaa.gov/os/assessments/pdfs/derecho12.pdf

[8] Ice Storm of 2005, The Lima News (newspaper). http://limaohio.com/archive/254/news-home_top-news-50968667-ice-storm-of-2005. And; Ohio (Auglaize County) Emergency Management Agency. http://www.auglaizecounty.org/ema/ema_pdf/Annual_Report_2005.pdf

Legality of Interfering Radiation

As stated earlier, the bulk of interference complaints far exceed the F.C.C. RF limits. However, the F.C.C. is ignoring the problem. It is bad enough that the interference is impacting so many citizens on so many levels. But if the F.C.C. refuses to enforce interference RF emissions, then perhaps Part 15, should be stricken from all legal record. Optionally, perhaps Congress needs to investigate the agency and ask "why aren't you doing your job?"

When revisiting Title 47: Telecommunication, "PART 15—RADIO FREQUENCY DEVICES". Look specifically at these paragraphs and how they apply to interference;

§15.17 Susceptibility to interference.

§15.31 Measurement standards.

§15.109 Radiated emission limits.

The public utility claimed they were exempt from §15.217 to §15.242 because their system's emission was not an RF transmission device. However, noise directly emanating from power lines clearly violates the letter of the law.

Jamming of cellphones and other communication devices are clearly illegal. The F.C.C. has had many rulings and forfeitures in this matter.

The law does not separate nor grant indemnity from jamming and interference due to gross disregard, or a manufacturer ignorance of emission limits. Clearly, the intent of the law is violated and parties managing infrastructure or manufacturing these devices are guilty.

Again, since the F.C.C. is the managing agency for spectrum, and thus needs to address the problem.

Conclusion

For years the level of interference from terrestrial noise sources has steadily increased. The interference issue is not unique to the United States. Other countries struggle[9] with noise. What is different is other countries have recognized the problem and threat to citizens. They have begun working toward resolutions, which includes the prosecution of violators.

With analog devices the consumer was able to identify interference. With digital devices the majority of consumers do not know why a device stops working or performs poorly. The public has been cheated out of receiving the quality and performance they expect from their purchase.

The public is also threatened by buying safety and security equipment which may not work due to interference from other equipment. Interference and noise is a direct danger to citizens impacting their ability to access NOAA WX Radio, EAS, amateur radio, and is a threat to law enforcement and first responder communications.

Interference and noise has forced broadcasters to incur losses in audience, revenue, and public service. One has to reasonably question if AM/FM/TV broadcasters are damaged with malice, and should be compensated for losses of service area or viewer/listeners.

Interference is not being corrected by those causing the problems when notified. Some offenders continue to cause interference with impunity. This must stop, and the F.C.C. must do their job.

F.C.C. staff understand the problem. *"Part of the problem*", says FCC Commissioner Ajit Pai, "*is that the AM signal is getting increasingly hard to hear*." Quote: *"Whether you're outside and you're getting interference from a power line, or you're inside and everything from the bulbs in your house to the cable box on top of your TV send out signals that conflict with the AM radio signal, and so for broadcasters trying to reach an audience, it's more and more difficult for them to do that,"* [10] So the question has to be asked, why isn't the F.C.C. doing their job?

The F.C.C. should give all users/manufacturers <u>3 months</u> to eliminate intentionally or unintentionally interference. Additionally, the F.C.C. should require all manufacturers of equipment out of compliance to inform their customers by mail or advertisement that they own a device which is non-compliant.

Public utilities, municipalities, and common carriers should publish a contact phone number in each community where they provide service for reporting interference. Once reported, a resolution should be made within three business days. All correspondence in these matters shall be public record. Fines should be implemented when owners of offending devices do not exhibit a reasonable resolution the problem. Financial compensation should be made to victims for interference, or providing materials and labor at no charge for the resolution to the problem.

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[9] (Requires translation) https://www.veron.nl/nieuws/zonnepaneelinstallaties-geven-vaak-problemen-als-gaat-om-vervuiling-ether-radiostoring/

[10] National Public Radio news story, December 3, 2013. http://www.npr.org/2013/12/03/248362533/fcc-proposes-changes-to-give-am-radio-a-boost